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Royal Commission

on

Electric Power Planning

THE DEMAND

FOR

ELECTRIC POWER

ISSUE PAPER #2 DECEMBER 1976

Ontario

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FOR
ELECTRIC POWER

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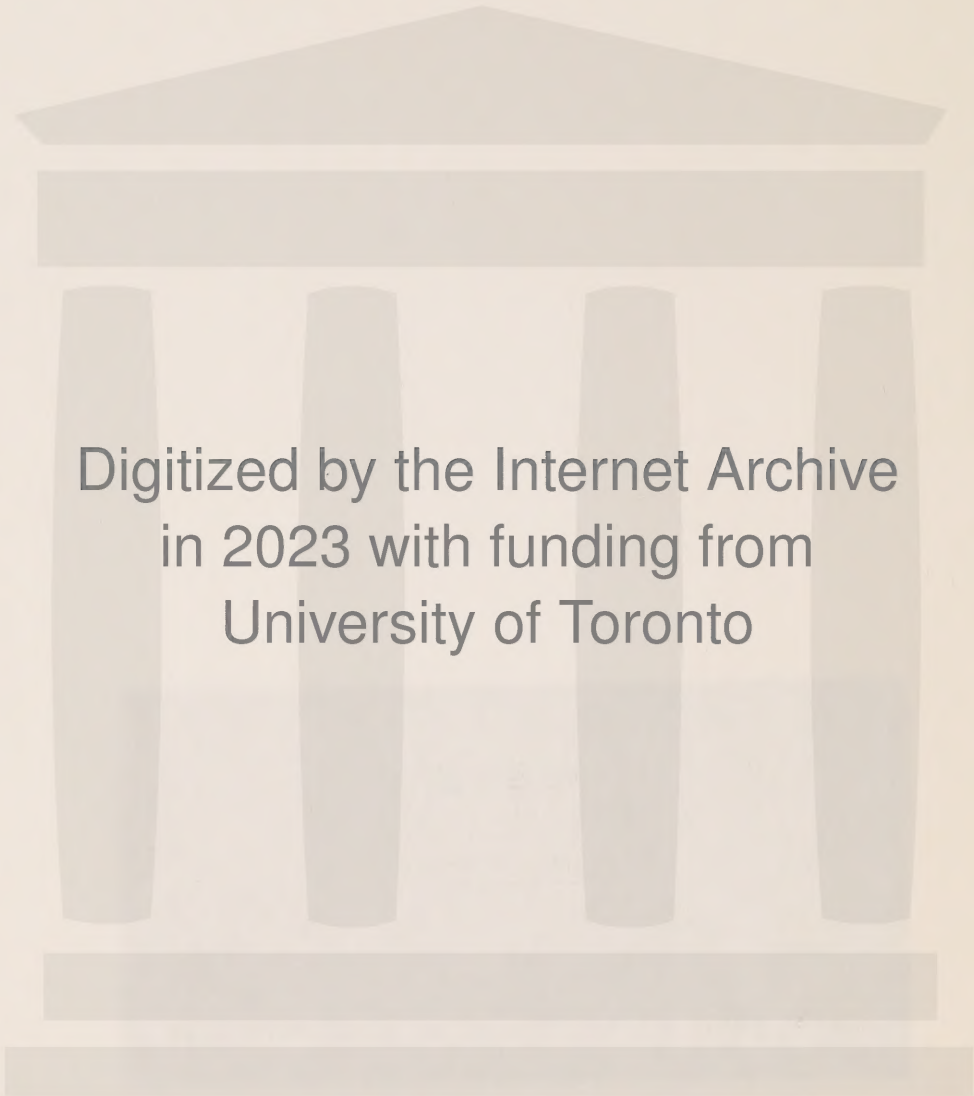

ISSUE PAPER #2

THE DEMAND FOR ELECTRIC POWER IN ONTARIO

CONTENTS

Introduction

I Demographic Issues

(a) Growth in population
(b) Nature of population
(c) Geographical distribution of population

II Economic Activity

(a) The provincial economy and the demand for electric power
(b) The price of electricity
(c) Forecasting the demand for electric power
(d) Productivity

III Conservation

(a) Education
(b) Environmental factors
(c) Technological factors
(d) Load management
(e) The management of thermal and other wastes

IV Utilization

(a) Utilization by ector
(b) Reliability considerations
(c) Efficiency of utilization
(d) Climatic considerations

V Time-Frames

VI Lifestyles

(a) Changing patterns of demand
(b) Limits to growth

CONTENTS (Cont'd)

Appendix A

References to demand during the preliminary public meetings.

Appendix B

References to demand in the public information hearings.

B-1 Transcript references
B-2 Ontario Hydro memoranda
B-3 Ontario Government ministry submissions
B-4 List of relevant exhibits

Appendix C

Research and background papers developed by the Commission which are relevant to this topic.

ROYAL COMMISSION ON ELECTRIC POWER PLANNING

THE DEMAND FOR ELECTRIC POWER

Introduction

Since its inception the Commission has recognized that a vitally important part of its mandate is educational in nature - education of the Commission itself and education of Ontarians in general. Indeed this factor gave rise to the idea that a series of issue papers should be published in which concise and logical statements of the key issues relating to electric power planning would be introduced to facilitate understanding and to lay the ground work for the final phase of the public hearings. This second issue paper deals with the demand for electric power. We believe this issue to be central in the Commission's inquiry. For instance, in the recent submission of the Sierra Club of Ontario with respect to the Public Information Hearings (November 2, 1976) we note:

> "We believe that the issue of uppermost importance remains that of critical examination of the demand projections which have been made for electric power."

Why is the issue of the future demand for electric power so important? * During the preliminary meetings and the public information hearings, of the Commission, the topic has been raised many times. Perhaps the reason is that the demand for electricity is so closely related to the future growth of Ontario - growth of population, growth of industry to provide jobs for an increasing labour force, growth of social institutions (health, education and public service), growth in food requirements, etc. And, what about such factors as the effectiveness of energy conservation measures, the impact of electric power developments on environmental quality, the availability of primary fuels, the development of alternative energy sources and their relative prices, and certainly climate, etc., which will affect future electric power demand patterns. Furthermore, electricity demand (and consumption) is related to life-styles (in the sense of the extent to which conservation and "belt-tightening"

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* The related issue of the future demand for energy, as a whole, is of even greater importance. Countries such as Canada and the U.S.A. with high energy/GNP ratios, have traditionally had relatively cheap energy. But this is changing rapidly and the changes will have widespread impacts.

are practised), to quality of service in the sense of reliability of service, to pricing policies and rate structures, to load management practices, and, not least, to legislative edicts (in the sense of regulatory processes). It is also related, of course, to how effectively electric power and electric energy are utilized.

It is a truism that the future demand for electric power and for electric energy will be related to the future availability of electric power generating and transmission capabilities (i.e. to the future supply of electricity). But it is not so obvious that "power" and "energy" have different economic implications, as well as scientific definitions. As a simple "rule of thumb", for example, we can equate "electric power" to generating (and transmission) capacity which in turn necessitates capital requirements. On the other hand "energy" can be associated with the fuel requirements for generation, and economically with the cost of the fuels. Accordingly capital is required to generate power and fuel is required to generate energy - energy costs are, of course, a combination of fuel costs, interest on capital, operating and maintenance costs.

Future electric power demands and their fulfilment will affect many aspects of life. It is for this reason that we introduce this demand issue paper on a somewhat philosophical note. This is necessary because, in the words of G.A. Lincoln ("Science", vol. 180, p. 155):

> "The problem (energy demand) spans not only the traditional physical and engineering sciences, but also those sciences which deal with human attitudes and actions, that is, the social sciences and include a more fundamental understanding of underlying economic principles."

There are clearly many interactive dimensions to the electric power demand issue - economic, ecological, environmental, health, social, technological, etc. Perhaps this is best illustrated by considering such human choices as:

(a) The need for environmental protection on one hand and/or, on the other hand, the development of needed energy supplies. (Some level of compromise may be necessary.)

(b) The high capital costs of some energy conservation measures (e.g., solar energy and district heating systems) together with their long term economic advantages on one hand and/or, on the other hand, the utilization of highly priced energy sources with uncertain futures.

(c) The greater convenience of, say, electric space heating on one hand and/or, on the other hand, the possibility of lower energy bills through the use of alternative forms of space heating.

The complexity and great difficulty of assessing the future demand for electric power is due essentially to the long lead times (which may be as long as twelve to fourteen years in the case of a major generating facility) in building new facilities. If, for example, only a year or two years were involved the prediction of future electric power (or indeed any form of energy) requirements would be greatly simplified. In reality, however, there are so many variables and parameters, so many unknowns, so many unpredictable events that one is tempted to conclude that the task is impossible. And yet the process of anticipation of the future is innate in the evolution of all biological species - man is no exception, indeed, at least to some extent, he has the potential to "shape his future".

A vital aspect of evolution is the recognition and development of behavioural patterns and trends in society. The Commission is endeavouring, for example, to recognize trends in Ontario society - especially those related to the future demand for energy. We will be successful only if a broad cross section of Ontarians provide us with indications which relate to their desired future life-styles.

Homo sapiens, because of the continually changing nature of the physical, biological and societal environment, in order to survive, must, as we see it:

(a) Continually ensure, through the educational process (not only formal education), that as many people as possible have an understanding of the nature of the issues facing society. (Their curiosity must be stimulated. Information relating, for example, to the future demand for energy and how it might be provided must be available in understandable form. Hence this issue paper.)

(b) Establish laws and machinery which hopefully enhance survival chances in as many respects as possible and which embody, where relevant, the knowledge and wisdom of countless generations.

(c) Continually probe the environment to assess whether existing laws and institutions and processes continue to apply as society projects itself into the future. Note, in this regard the intrinsic relationship between "issues" and "probes" - we define and structure the issues (as we are doing in this paper) and then develop appropriate probes (i.e., experiments). Probes lead to innovations which are the mainspring of society.

(d) Implement hopefully by voluntary participation, those theories and philosophies which experiments indicate will probably be beneficial to society. In some cases implementation may involve the enactment of regulations and their enforcement, in other cases implementation may involve technological change - in the field of energy, for example, the introduction of technologies which are predicated on minimizing waste and conserving irreplaceable resources.

Any consideration of the changing patterns in the demand for energy must be predicated*, for example, on:

- The demand for food (e.g., the conversion of chemical energy to protein).
- The demand for thermal energy (i.e., space heating, water heating, process steam, etc.)
- The demand for mechanical energy (i.e., transportation of all forms, machine tools, cranes, etc., and a multitude of examples in our everyday lives e.g., elevators, vacuum cleaners, washing machines, etc.)
- The demand for electromagnetic energy (i.e., artifical light, radio and television transmission)
- etc.

These demands can be supplied by several primary sources of energy such as solar energy (in the form of hydro-electric power, or via photosynthesis to create food, or via wind power, etc.), or from fossil fuels or nuclear fuels. Some of the demands are best fulfilled by first burning fuels to create electric power e.g. electric lighting, while others may be best fulfilled by converting the thermal energy of combustion of fuels directly to mechanical energy via, say, the internal combustion engine. We have a very

*In the section on "Utilization" (page 16) we shall introduce, in addition, the fundamental idea that the need for energy by an organism, by all animals (including man), and by society is predicated on two, and only two, factors; (a) energy needed for growth; (b) energy needed for maintenance.

broad range of choices and this issue paper is concerned with some of them.

We have to differentiate, moreover, and this is tremendously important, between the "need", and the "demand" for electric power. There is a subtle difference which is illustrated; perhaps over-simplistically, by equating "need" with "demand" minus "waste".*. In other words "need" should take into account the potential impact of conservation measures and especially should be predicated on the efficient utilization of energy. Ideally, perhaps, we should equate "need" with "supply" (or better still "reliable supply").

There will continue to be changing demand (and need) patterns. It is largely a question of how effectively people adapt to changes which may be both self-imposed and externally imposed (e.g., the effects of the increasing costs of oil and natural gas). We have found it interesting to consider the analogy of the "game" - and note that society as a whole is necessarily playing the game of "survival". Games in many respects are one of man's most important inventions (perhaps second only to language). All competitive games involve rules - these correspond in the analogy to the laws and mores in society. Most games involve strategies and foresight - so does life. The more adaptive a team is to the circumstances (i.e., the environment) and to the tactics of the opposing team the better equipped it is to succeed - so it is with society.

When we analyze the reasons why the demand for electric power has increased so rapidly, all over the world, since the beginning of this century, we find that, in large measure, its flexibility is the key factor. Electric power adapts very readily to the demands of modern technological society. Before it was harnessed, the shape of industry, of agriculture and of the home was determined largely by the science and technology of mechanics and thermo-dynamics (e.g., the steam-engine). After the advent of electric technology there was a massive "speeding up" of all kinds of processes because of the enhanced ability to monitor and control processes at increasingly higher speeds and concomitantly with increasing utilization of energy.

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* "Waste" in this respect should be interpreted as "dripping faucets", "lights left on", etc., rather than in the strictly thermodynamic sense. Perhaps a more meaningful relationship might be:

Need = Demand - Non-essential utilization.

It is noteworthy also that the harnessing of electricity has, of itself, given rise to many new technologies and to many cultural changes. Consider the following list for a start:

(a) Communications technology e.g., the telephone, radio television, radar and their societal implications.

(b) The modern general-purpose electronic digital computer and the vast computer communications networks which encircle the globe (whether for good or ill is another matter!).

(c) The development of electronic instrumentation for industry as well as systems for medical diagnosis and therapy, e.g., X-rays, the electro-encephalograph, the electro-cardiograph, the electron-microscope, the laser, ultra-sonic methods of detecting tumours, etc. (The whole field of health care and the study of the causes of disease, has been transformed since the advent of electricity in manageable form.)

(d) Electronic controls and navigation systems for the aircraft and aero-space industries.

(e) The applications of electric technology to agriculture giving rise to the concept of the "electric farm".

(f) Metallurgical processes based on electric technology e.g., arc furnaces.

(g) Sport, e.g., the ice requirements for hockey, the lighting requirements for night baseball games; the timing of various sporting events; the display boards used in many sports; etc.

The issues relating to the future demand for electric power are presented and explained in the following sections. There is an unavoidable degree of overlapping between, for example, "demand issues" and issues which relate also to "generation and transmission", to "environmental impact", to "land use", to "financial and economic issues", etc. The point is, of course, that the concepts upon which electric power planning is based, or will be based, are of an interdisciplinary kind. And that's what makes the work of the Commission so interesting.

I Demographic Issues

A central factor in assessing the future demand for electric power in Ontario is growth of population. Ontario population projections, undertaken by the Ontario Ministry of Treasury, Economics and Intergovernmental Affairs, and other agencies, for the year 2001 range from 9.3 million to 13 million people.

Assuming a middle of the road figure of 11 million and assuming a constant level of per capita electricity consumption we could produce a "reasonable guess" for future electricity demand. However, there are many factors such as the fertility rate, (the average number of children a woman has in her lifetime), mortality rate, the net in-migration rate (the gain in population of Ontario from outside of Canada and migration of people to Ontario from other parts of Canada) and demographic patterns which will determine the future population of the province.

Various indicators exist, such as the post-World War II "baby boom", which suggest population trends and which give a rough indication of the age distribution which might apply for the period 1983-93 and beyond. For example, essentially because of the "boom", the number of homes needed and households established, in Ontario, is increasing more rapidly than a decade ago, and will probably continue to do so until at least 1985. On the other hand, although there is a probability of the number of births increasing during the 1970's and the early 1980's there is also a possibility that the birthrate will be lower than anticipated because of an increasing proportion of women being in the labour force. This latter factor may well give rise to a greater relative population growth in urban areas.

A significant component of Ontario's growth in population and economic development has been a fairly high level of net migration which peaked about 1966. It has been declining since then.

The "electric power demand issues" which relate to the demography of the province are outlined below:

(a) Growth in population

The future peak demand for electric power and the total electric energy requirements per annum will clearly depend on the number of people, and relatedly on the number of households, in Ontario, ten, twenty, thirty, etc. years hence. Estimated population levels are an important input to the electric power demand forecasts. The associated issue facing the Commission is - will the average annual growth in the population of Ontario drop much below the 2.1% growth rate it averaged during the period 1958-73? Should future electric power demand (needs) be predicated on an appreciably lower growth rate - say 1.2%?

(b) Nature of population

During the 1970's, and the early 1980's, the population "bulge" arising from the post-war baby boom will give rise to an increase in the "home-buying sector" of the population. Furthermore the percentage component of the "over-65's" will probably continue to increase. These demographic factors will clearly influence the demand for electric power in the residential, commercial and industrial sectors of the economy. To what extent are extrapolations of historical demographic data adequate to evaluate future electric power demands (needs)?

(c) Geographical distribution of population

Demographic patterns are not very responsive to governmental control. Immigration is, of course, a federal responsibility and the provinces have little or no ability to influence the extent of interprovincial migration. At the provincial level, on the other hand, the government has some influence on the regional distribution of population within the province. It is not unlikely that, although each major region of the province will experience some growth in population over the next quarter century, there will probably be marked shifts in the distribution of population across the province. It has been suggested, for example, that central Ontario is likely to increase its share of the province's population and that the marked trend, over the past several decades, towards concentration of population in the major urban centres will probably continue. Issues related to the distribution of population and its possible impact on the future demand for electric power appear to be:

- Is there likely to be a gradual shift in population patterns? e.g., will growth in the less-populated areas of the province be stimulated by locating new industries in these areas and cities?
- If a major effort is to be made in connection with the protection of high quality agricultural land should this result in steps being taken to persuade industry and people to locate in areas not suited for food production?

- If the trends indicated in the above appear to be likely what are the implications for the planning of the electric power system? e.g., what effects would this have on the size, nature, and siting of electric power generating stations and associated transmission lines?
- Assuming a shift in regional development priorities to ensure some relocation of population would the labour force in the province react positively? Would immigration be encouraged to fill gaps in the labour force?
- During the past two decades there has been a marked increase in the proportion of women, especially married women, in the total labour force - will this increasing participation continue? If so, to what extent will it affect the future demand for electric power especially in the residential sector?

II Economic Activity

The extent to which economic growth, on a per capita basis, will continue to increase over the next decade or two is obviously associated closely with the future demand for electric power in the province. It is well known, historically, that growth in demand for electric power has been correlated positively with the growth in gross provincial product in Ontario and gross national products in Canada, and the United States but not in other industrialized nations such as Sweden. It is for this reason that during the recent Public Information Hearings, the Commission has been seeking information from industrial associations, individual industries and financial institutions relating to how they envisage the prospects for growth (or for non-growth). But the Commission considers that this is an area in which debate should be conducted as openly as possible so that maximum weighting can be given to the wishes and the opinions of the public as a whole. If, for example, it is considered desirable, and perhaps even mandatory, to slow down the rate of growth of the per capita consumption of all forms of energy then governments might be forced to introduce legislation aimed at ensuring an increasing level of conservation of non-replaceable fuels and materials.

(a) The provincial economy and the demand for electric power

It has been said that: "Energy means jobs and income". In the past, because electricity was so cheap, and readily

available, its role in shaping the economy was all but ignored. However, as mentioned above, the use of electricity and the Gross Provincial Product have risen or fallen together maintaining essentially a parallel relationship. Of course GPP is shaped by other factors as well, such as the size of the labour force and the rate of productivity improvement.

Task Force Hydro Report # One - "Hydro in Ontario - A Future Role and Place" attests to the success of Ontario's electrical system:

> "In spite of the need to reassess Hydro in the light of requirements for the decades ahead, the co-operative partnership between Ontario Hydro, the municipalities and the Government of Ontario has been a dramatic success story. One of the most rapid rates of industrialization in the world has been served and facilitated and Ontario residents have been provided with electricity at very low rates compared with other provinces and the United States without the inconvenience and economic loss experienced through brownouts. At the same time, Ontario Hydro has achieved a reputation among its peers as a world leader. It has been of immeasurable service to the Province of Ontario."

Some of the issues, to which the Commission's attention has been drawn during the Preliminary Meetings and the Information Hearings held to date, which relate to the provincial economy and the demand for electric power, are outlined below:

- The Canadian per capita use of energy is the second highest in the world (Norway ranks first). Will the historical growth patterns in the energy needs of the industrial, agricultural, commercial and residential sectors persist over the next two decades or will growth rates be decreased?

- An associated issue relates to the historical growth patterns on a per capita basis - will these persist or will they be reduced markedly? For instance the per capita consumption of electrical energy during 1958-73 increased at a rate of 4.5% per annum (i.e., per capita electricity use doubled during this 15 year period), while the primary peak power demand increased at an average annual rate of 6.7%. In 1958 electricity constituted 11.1% of the total energy consumed in the province. This percentage rose to 14.2% in 1973 and it has been estimated that at present it is between 15% and 16%. The overall annual growth rate in primary electricity sales 1958-74 was 7.1%, while the increase in ultimate customers was 2.5%.

- Will there be significant changes in the growth in demand for electricity in various regions of the province?

(b) The price of electricity

The recently published "Electricity Costing and Pricing Study" by Ontario Hydro (October 1976) is so far-reaching in its implications that it behooves the Commission at this time to await the outcome of the Ontario Energy Board's consideration of the study and its recommendations before publishing a comprehensive statement of the issues. However, the Commission has already identified certain specific issues and concerns, relating to pricing structures and policies, which have been brought forward in its preliminary meetings and hearings. These are summarized below:

- What is the likely impact on demand of increased electricity prices on households in different income groups?
- Will increasing electricity prices change the patterns of consumer utilization? e.g., will there be more consciousness of electricity usage?
- To what extent should the pricing of electricity and associated rate structures be used to influence the consumption of electricity?
- What are the possible secondary effects of price increases? What would be the overall impact on the provincial economy?

(c) Forecasting the demand for electric power

During the past 50 years the demand forecasting techniques used by Ontario Hydro have been accurate by standards of North American utilities and have contributed to ensuring that a reliable supply of electric power has generally been available to an increasing number of consumers whose requirements have, on a per capita basis, continued to increase over the years. These forecasting techniques have been based on the extrapolation of historical trends and the individual projections of the public utilities commissions, together with the load forecasts of major industrial users (in particular, pulp and paper, iron and steel, chemical and petrochemical, etc. companies).

More recently, consideration has been given to the applicability of "econometric models" as well as "time series extrapolations". A mix of both methods together with the application of judgement, based on many years of experience, provides the load forecasts which are currently in use. But it is becoming increasingly clear that the expected errors in load forecasting (statisticians measure them in terms of "standard deviations") are likely to increase because of the increasing uncertainties confronting industrial society. For example, such uncertainties as the future availability and the price of crude oil from the Middle East; uncertainties relating to the availability of capital for industrial expansion; uncertainties relating to

climatic changes (which may have a profound impact on agriculture, on energy requirements and on the availability of hydro-electric power from some installations).

Consequently there appears to be a pressing need for the public to make their views known regarding such basic issues as the following:

- What factors should be included in determining the future demand for electric power? (e.g., financial considerations, conservation practices, security of fuel supplies, reliance on other energy sources for basic needs).
- Is it desirable, or possible, for the electric load forecasting process to be conducted (insofar as the weighting of acceptable criteria is concerned) in a public forum?
- Does government have a role in the forecasting of electric power needs? (e.g., the establishment of a "Select Committee" or Ontario Energy Board hearings to review from time to time the basic criteria upon which the load forecasting procedure is based).

(d) Productivity

During the 1960's there was a marked shift in the percentage of gross provincial product originating in the goods producing sector to that in the service sector. This trend appears to be continuing, although at a somewhat lower rate. Furthermore, there is some indication that the electrical energy requirement per employee in industry has stabilized although the productivity per employee continues to grow albeit more slowly than formerly. The Commission is seeking more information as to the implications for electrical requirements as a result of these forces.

III. Conservation

The future growth rate predictions of the demand for electricity in Ontario vary widely. Some argue that over the next 15 years the annual rate will continue to be close to the trend over the past 15 years despite increased prices, despite a declining growth rate of the Gross Provincial Product and despite a slower population growth. They argue that our present lifestyles are based on extensive energy use and that they won't change. Others feel that increasing prices, the capital costs of energy development, the applications of a strong conservation ethic, and continuing concern with the quality of the environment will decrease the annual growth rate during the

next decade, and that this trend will continue until zero energy growth rate (per capita) is achieved followed by negative growth.

Conservation is a much used and much abused term which requires some definition so that coherent discussion can take place. Conservation implies the wise and careful use of a resource. It does not follow necessarily that an activity or service has to be restricted but rather that the activity or service is provided with less waste. We can conserve energy if houses are built or retrofitted with better insulation. The service in each case remains the same but energy is saved because there is less waste. How much energy can be saved by comparatively simple means, without changing the level of service (or lifestyle) provided? Some participants in the hearings have suggested that we can save up to 30% of our total energy use this way. Others were less optimistic.

In either case a question arises as to what will provide the motivation to change our habits, or to plan further into the future. Is an education program enough or will a drastic rise in the cost of energy be necessary? Will government have to attempt massive regulation programs or will a well handled marketing effort be effective?

Freedom of choice is an essential thread in our social fabric and while conservation measures, strictly imposed, may be seen by some as a threat to this freedom, a successful conservation programme could result from informed people choosing to change their consumption patterns. During the hearings it was even suggested that conservation practices might actually enhance our lifestyle by introducing or reviving such qualities as simplicity, thrift, craftsmanship and diversity.

Much has been written and spoken about the importance of society embarking upon rigorous and comprehensive programmes of energy conservation. The conservation ethic appears to be one which is acceptable, at least in principal, to a broad cross-section of the people of Ontario, to their governments, both federal and provincial, and in the main, to the utilities which serve them. Many aspects of the current way of life of Ontarians will probably be examined in the future with a view to ascertaining what changes might be desir-

able and how these might relate to the conservation of energy.

However, it is not the purpose of this issue paper to outline specific methods which have been suggested to conserve electric energy but rather to identify and explain the associated issues.

Some of the issues relating to conservation which have been identified are:

(a) Education

How can the importance of practising conservation measures be brought to the attention of the people especially through the educational process? What is the role of the media?

(b) Environmental factors

Environmental protection and energy conservation are frequently thought of as being essentially the same or at least being very closely associated - how does this association involve the future demand for electric power bearing in mind that electric power is often needed to "clean-up" the environment?

(c) Technological factors

Various technological systems have been suggested as a means of conserving the primary fuels e.g., district heating systems, solar energy for space and water heating, heat pumps, etc. - these systems necessitate capital expenditures, in varying degrees, and, from an economic standpoint, their worth is only demonstrable after several years. How can this apparent dilemma be resolved? - through tax incentives? through special financing processes? etc.

(d) Load management

An indirect approach to the conservation of energy is via the procedure referred to as "load-management". The purpose of load management is to obtain a more constant level of demand, over the 24 hours of the day, by shifting some of the peak demand to periods of comparatively low demand, i.e., by smoothing the peaks and the valleys. This is especially important during the winter months. A related problem is to consider load management on an annual basis and by bringing into the picture electric power systems which are interconnected with Ontario Hydro. For example, a system contiguous to Ontario Hydro may have "summer peaking conditions" contrasted with Ontario's "winter peaking conditions". What are the implications and possibilities of increased electric power exchange from the point of view of conservation and indeed economics?

Bearing in mind the capital cost of "ripple control" (a system in which the utility or in some cases the consumer, can curtail the electric load or part of it in a home, factory,

school, etc., during "peak" demand periods and transfer it to "valley" demand periods), what is the potential of such techniques from a conservation standpoint? If desirable, how can their wide-spread adoption be stimulated? Toronto Hydro and a few other utilities in Ontario presently control some water heaters on their system by a centrally operated switching mechanism but this control extends to only a small proportion of the Ontario water heating load.

(Note: In connection with "load management" it should be stressed that modified electricity pricing policies, such as those recommended in the recent Ontario Hydro "Electricity Costing and Pricing Study" could, if adopted, have important effects on the "electric load profile", both on a yearly and on a daily basis. The recommendations of these major studies will be considered by the Ontario Energy Board through public hearings. It is understood that the proposed rate structures could be in effect by 1979, and since the Commission's terms of reference relate to the period 1983-93 and beyond, some degree of anticipation of the changes may be justified.)

(e) The Management of thermal and other wastes

It is well known that vast quantities of waste thermal energy are discharged from thermal generating stations (also from homes, from factories, from office buildings, etc.). An issue which has been raised on many occasions - can this waste energy be utilized effectively, for example, to expedite food production? or to provide space heating in homes and factories?

If it is considered desirable to slow down the rate of growth in demand for electric power by concentrating on reducing waste in all forms (i.e., not only wasted thermal energy, but wasted food, various kinds of garbage, etc.) might this be achieved by:

i) Voluntary responses or mandatory restraints?

ii) Tax relief policies to encourage the development of efficient equipment, the insulation of homes, etc.?

iii) Changes in building code requirements, restrictions on the wattage of certain appliances, bans on the manufacture of certain equipment?

iv) Regulations relating to the heating and lighting of public buildings?

v) Other means?

Should policies be developed based on some or all of the above possibilities?

The policies and associated decisions relating to the above will hopefully be predicated on a belief in the ability of Ontarians to act responsibly and rationally, and consequently on the concept that the public be fully informed before essentially irrevocable decisions are taken.

IV. Utilization

Fundamentally, the need for energy by an organism, by man, and by society is based on two, and only two, factors; the energy needed for growth and the energy needed for maintenance respectively. This simple truism underlies all considerations relating to the utilization of energy. For instance, because the population of Ontario continues to grow, albeit at a somewhat reduced rate, additional energy is required to sustain this growth and, if living standards are to be maintained, there is a continual need for energy to maintain them (e.g., to provide food and jobs respectively, to power the elevators, the subway trains, the stoves, the furnaces, agriculture and industry, etc.). This is an important distinction. It contrives to put energy planning into its broadest perspective. Cognizance of it will probably facilitate the debate phase of the Commission's inquiry by clarifying the issues relating to demand and to the utilization of electricity. A simplistic speculation, based on the analogy of the growth and maintenance of the human being, is that society might achieve its major gains in the optimization of the utilization of energy in the "maintenance" area. This is worth thinking about and some of us are doing just that!

However, in this paper it is convenient to consider "utilization" (of electric power and energy) from several points of view. For instance, what are the respective levels of utilization of electricity in key societal sectors? What are the reliability implications of electricity utilization? Can electricity be used more effectively? How do climatic conditions and climatic changes affect electricity utilization?

(a) Utilization by Sector

The demand for electricity in Ontario results from a complex interplay of the requirements of people, largely through the residential, commercial and industrial sectors of the economy. Differential growth rates over the past decade have changed the relative shares of electricity in these major market segments. Although industry is still the major consumer, commercial consumption and to a lesser degree residential use, have both increased markedly. See table I

TABLE I

Electricity use and trends by market segment

(in million megawatt hours)

	1966	1974
Residential	12.6	23.8
Commercial	8.9	20.6
Industrial	22.2	31.4

The agricultural segment is represented in both the residential (farm dwellings) and the industrial sectors. For 1966 agricultural use was .9 million MWh under residential and .3 million MWh under industrial. For 1974 the corresponding figures were 1.1 million MWh and .8 million MWh.

During this same period, 1966 to 1974, residential households increased at an average annual rate of 3.5%. The average increase in commercial employment was 4.9% annually while industrial employment increased at an average annual rate of 1.2%

Heating applications of electricity predominate in the residential sector. Space heating and water heating have represented a total of about 50% of average residential electric energy consumption since 1951, with space heating becoming increasingly more important. In 1941, 80% of Ontario homes were provided with electric lighting, by the mid 1960's virtually all homes were electrified.

Some of the issues relating to the possible future utilization of electric power are summarized below:

- What are the prospects for conversion of fossil-fired processes to electric processes in industry? In the commercial and residential sectors?

- To what extent will environmental requirements (i.e., clean air and water) result in increased utilization of electricity?

- To what extent will electric forms of transportation (i.e., railroads, urban transit systems and the electric van and automobile) constitute a significant component (say 10% of electric power utilization by 1990-2000)?

- Will it be desirable and practical to evolve "power and energy accounting" systems, especially in commerce, government and industry, in much the same way as "cost accounting" is carried out at present?

(b) Reliability considerations

Reliability of an energy supply system can be interpreted in two ways; first, in the sense of the security of the associated fuel supplies (an insecure resource base cannot give rise to a reliable source of energy) and secondly, in the sense of its uninterrupted availability.

As the reliability (in the sense of security) of oil and natural gas resources diminish say, in Ontario, the dependence on electric power will probably increase. In the case of Sweden, it is interesting to note that, assuming the goal of zero energy growth per capita will be achieved by the mid-1990's, it will probably be accomplished by large cuts in the consumption of oil, indeed it is anticipated that electric power utilization will continue to grow at a rate of 3-4% per annum.

Assuming secure fuel supplies, the reliability of an electric power system depends essentially on the "reserve margins" in generating capacity and also in transmission capacity. The reserve margin in generating capacity is related also to the "load factor" - in simple terms, this is the percentage of time during which the generating facilities operate at full output in a twelve month period. The reliability of supply is particularly significant when the power demands are at "peak" levels. During the spell of cold weather in Ontario at the end of November and the beginning of December 1976, for example, Ontario Hydro was hard-pressed to maintain quality of service during the peak periods because unexpected outages, due to mechanical problems, occurred at a major thermal generating station (Nanticoke). This recent experience exemplifies the importance of "reliability in prospect" in contradistinction to "reliability in retrospect" - in other words reserve margins should ideally be based on what might be described as the "worst conceivable conditions" which may arise during a specific day or a specific week in a future year.

The major issues relating specifically to reliability appear to be:

- Bearing in mind the relationship between "reliability" and "reserve margins", are the existing reserve margins, and those projected, about right or too large or too small?
- Should there be more or less reliance on interconnections with other utilities to ensure adequate reliability?
- If reserve margins are reduced in the future, to what extent would selective load shedding, voltage reduction, "ripple control" systems, etc., be acceptable, in order to maintain quality of service, to the majority of customers?

c) Efficiency of utilization

Bearing in mind the conservation concepts and issues introduced in the last section, how effectively is electric power and energy being utilized? Can the efficiency of use be improved?

These are central issues. In other words can energy be conserved by concentrating on needs rather than on demands on one hand and by using energy in an optimum way on the other hand? We like to think of the former as being related exclusively to human needs and frailties, and the latter to the science and technology of energy conversion. This may sound rather complicated; all it means, however, is that society should be continually striving to determine the source of energy which best fits a particular requirement. This is an aspect of the total energy problem which has not been given the attention it deserves essentially because all forms of energy have been cheap and therefore very easy to waste.

In all sectors of society the efficiency of utilization of electricity depends in large measure on the quality of design of appliances, machine tools, buildings, etc. How high is the thermodynamic efficiency? How good is the insulation? etc. Efficiency of utilization also depends on how an appliance, tool, etc. is used - even the most exquisitely designed (from an energy efficiency point of view) appliance, or home, can be misused, e.g., T.V.'s left on continually, refrigerator or electric stove or house doors left open excessively, water in an electric kettle allowed to boil excessively, and so on and so on. Accordingly, the problem of increasing the efficiency of utilization of electricity (and indeed of all forms of energy), has both technological and human dimensions.

Although we usually hear more about the use of electricity in the home (because we are more familiar with domestic electric appliances, with electric space heating, etc.), the question of how efficiently electric power is being used in industry, commerce, agriculture and government is equally significant. Let's look at the industrial picture.

By far the largest use of energy in industry in Ontario (and in Sweden and in the United States) is for basic material extraction and processing i.e., the pulp and paper, iron and steel, chemical and petro-chemical, mining and metallurgical, etc. industries. And in each case the utilization of electricity is comparatively high (a single iron and steel plant might use as much electrical energy as a city with a population of 100,000). Such factors as the modernity of industrial equipment (older equipment was usually designed with little regard for optimum energy utilization because of the low cost of fuel and electricity) and the efficient utilization of primary energy (e.g., by the cogeneration of electricity and process steam) are of central significance. An example, based on Swedish experience is worth noting - it is taken from a recent article by L. Schipper and A. J. Lichtenberg ("Science", 3 December 1976, vol. 194, no. 4269):

> "Sixty percent of all fuel used in the paper industry (which consumed 15% of all energy in Sweden) is provided internally by barks and liquors, as opposed

> to 35% in the United States; but a third of the electricity used by that industry (and smaller fractions elsewhere) is cogenerated with steam production, thus reducing fuel needs."

In the same article there are comprehensive data which provide evidence which supports the oft quoted statement that the per capita use of energy in Sweden is only about 60% of that in the United States (and also in Ontario).

The major issues relating to the efficiency of electric power (and energy) utilization are stated briefly below:

- To what extent can the thermal efficiency of electric appliances be improved by "energy-conscious design"? Should standards of excellence in this respect be raised? What will be the potential impact on electrical power utilization?
- Is it desirable, or feasible, for government to require comprehensive studies of energy utilization (especially electric power) in energy-intensive industries bearing in mind both technological and human factors? Is electric power and energy accounting desirable and realistic?
- To what extent can electric power transmission losses be minimized? e.g., by the strategic location of new generating stations (note that environmental and health factors as well as economic factors are also involved)?
- Is it likely that new electric pricing policies (as outlined, for example, in the recent Ontario Hydro study) will be effective in ensuring more efficient utilization of electric power and energy?
- To what extent can improved utilization of electricity be achieved by technological change on one hand and through educational programmes on the other?
- It is well known that recycling of wastes of all kinds is an important method of ensuring the efficient utilization of primary energy - is society fully aware of this fact? Should governments encourage, through tax exemption processes, various recycling operations?
- Food is a vital form of energy and its production necessitates large expenditures of various forms of energy, including electricity. Millions of tons of food are wasted each year - how can "food conservation" be encouraged?

(d) Climatic considerations

Why is climate a factor in electric power demand (or need) considerations? Perhaps the well below average temperatures at the end of November and in early December of 1976, and the

concomitant pressures on Ontario Hydro's generating capacity is an answer in itself.

The amount of energy utilized in Ontario depends not only on the uses to which the energy is put (residential, agricultural, industrial, commercial, etc.), but also on the ambient (e.g., weather) conditions. For instance, the level of utilization of energy for space heating in a home or in a factory, clearly depends, not only on the desired indoor temperature, but also on the outdoor temperature, on the wind velocity and it may even depend on the humidity. Similarly many other physical (as well as biological) processes are "weather dependent" - consider, for example, the differential between the gasoline consumption per mile of an automobile when driven in winter and summer respectively.

Of the physical factors, as opposed to the economic, social and environmental factors, which will affect the future demand for electric power perhaps none is more important than climatic change. This is particularly the case in Ontario because of the comparatively (very, in many areas) cold winters and the warm summers. Furthermore, in contrast to the fact of "irreplaceable energy depletion" which, to a reasonable degree, is predictable quantitatively, there is universal agreement that, over the long term (i.e., say from six months to 50 years hence) climate is, within certain bounds, unpredictable. However, if the hypotheses recently stated by several highly respected climatologists - which postulate more climatic extremes, compared with the weather patterns of the past century, for many areas in the northern hemisphere - prove to be accurate, then the patterns of energy use may change equally dramatically. And it is clear that the peak demands for electric power would increase.

It should be noted moreover, that many activities of man, himself, especially those involving combustion of the fossil fuels, have been the cause of significant physical changes in the atmosphere, notably the CO_2 and particulate levels, and these will probably affect climate. The reliability of future energy supplies (fossil fuels, nuclear, solar, wind, etc.), will figure centrally in any assessment of the potential impact of more severe climatic conditions.

- To what extent should Ontarians take climatic prognostications of the above kind into account in speculating on future energy requirements? (This is an issue to which only the people can respond).

- What contingency plans should be prepared, if any, to handle energy short falls in extreme weather conditions? For instance, lengthy periods of drought, in critical areas, may not only have deleterious impacts on food production, but also on the production of hydroelectric power.

V. Time-Frames

It has already been pointed out that a major difficulty in planning electric power systems relates to the increasing length of lead-times (up to 12 years) involved in obtaining approvals, including land acquisitions, perhaps necessitating expropriation, environmental assessments and public participation, in addition to the time required for the design and construction of major generating and transmission facilities. Consequently, anticipation of future power needs assumes even more significance and becomes even more uncertain. The Commission's terms of reference refer to the period 1983-93 and beyond and this constitutes a time-frame which takes into account these long lead-times.

But the significance of time-frame in the planning process is related to other factors, as well as those mentioned above. For example, there are "time-frame" considerations relating to the availability of fuel supplies (both fossil and nuclear), relating to the voluntary or legislated levels of energy conservation which might be expected by, say, 1993, and relating to potential changes in lifestyles. Consideration must also be given to realistic time-frames associated with the commercial development of alternative energy sources (solar energy, wind energy, energy storage, etc. - these will be considered in Issue Paper #3). Of central significance too is the time-frame associated with the financing of major facilities.

The argument has been advanced that if the probability of a particular facility being required by some date in the future (say 1990) is high, then, assuming a continuation of inflation and an increasing scarcity of some commodities, the time to initiate such a facility is "now". Counter-arguments have been based on the possibility of reduced growth rates and the uncertainties of technological changes which may have an important impact on the planning of electric power systems (if, for example, a comparatively inexpensive photovoltaic cell were to be available within five years or so, the significance of solar energy might be appreciably enhanced).

There are many other aspects of electric power planning and associated matters which can be categorized as "time-frame" issues. Some of the more obvious are:

(a) To what extent can the "mix of generating facilities" (in the sense of both type and size) be used to reduce the magnitude and to minimize the impact of the excessively long lead-times associated with, for example, the development of large thermal generating plants? It has been stressed on numerous occasions that the maintenance of an adequate level of diversity and flexibility is important.

(b) Ontario Hydro has proposed certain steps to minimize the long lead times associated with the development and construction of major facilities. One of these is a procedure described as "Land Banking". The idea is predicated on the buying of land well in advance of its being required for a potential generating site and "keeping it in inventory". In this way, it is argued, several preliminary steps might be undertaken (comparatively inexpensive procedures) in parallel with, for example, hearings of the Environmental Impact Assessment Board and other public participation activities. Land banking would probably involve the consideration of several alternative "generating sites" from economic, environmental, and ecological standpoints. To what extent should "anticipation" procedures such as "Land Banking" be encouraged and how can the public participate most effectively in this process?

(c) The time-frames associated with developments in power-pooling and in the interconnections with contiguous utilities will probably be increasingly important in the future - can these developments be expedited?

(d) By definition, high technology, such as the modern electric power system, necessitates cadres of highly skilled technicians, engineers and managers. In considering the future development of Ontario's electric power system it is important to consider the future availability of such personnel. For example, it frequently takes many years for a company (e.g., a sub-contractor) to build up a team of competent qualified people to handle the engineering and production of complex system components. Because of fluctuating demands for these products it may happen that the skilled manpower pool associated with their production may drop below "criticality". Is this likely to be a problem in Ontario? If so, how can its impact be minimized?

(e) Inevitably there are health implications associated with the generation and transmission of electric power. In view of the "latency" period associated with the development of certain pathological conditions resulting from exposure to, for example, low-level radioactivity and such toxic gases as SO_2 and NO_x (the time-frame of such latency periods may embrace up to 30

or more years) how should such health implications be weighted in the planning of electric power systems?

(f) One of the most intractable areas in the technology of electric power systems is that of materials research and development. Materials (and gases) with special properties are required in nuclear technology, in solar energy technology, in the transmission of high voltage electric power, in high-power electric switching and transforming systems, etc. The associated metallurgical and materials researches have a broad spectrum of time-frames associated with them. These time-frame factors should be taken into account in long-term electric power planning - is this adequately appreciated?

Several of the above issues and concerns relate not only to future electric power demand questions but also to other aspects of the Commission's inquiry. They will be considered in subsequent issue papers perhaps from different points of view. What we are stressing once again is the holistic nature of complex systems such as the electric power system. Such a philosophy ensures that there is rarely a dull moment in the Commission's activities!

VI Lifestyles

The future demand for electricity in Ontario is closely related to questions of growth of population, commercial activity and industrial development as well as such factors as the potential level of energy conservation measures, the impact of electric power development on environmental quality and the availability of primary fuel at reasonable prices.

Our present lifestyle, our geography and our climate make us heavily dependent on energy. Because of our climate we need a large amount of energy to produce heat; because of our geography and the way we have built our cities, we need significant amounts of energy for transportation. As yet we do not have a satisfactory method for measuring the quality of life, comfort, convenience and leisure provided by electricity nor the social costs of expanding or not expanding our complex electrical system. Our urban settlements sprawl towards the farmlands and some sectors of society have vested interest in continued growth. In the fifteen year period, 1958-73,

our electricity use per capita doubled. We have become a throw-away society and perhaps our attitudes have been encouraged by the availability of cheap and abundant energy.

(a) Changing Patterns of Demand

The relationship between lifestyles and energy consumption is a complex one. While the expression "quality of life" has become more and more popular, its definition has not become correspondingly more precise. A basic factor which must be considered in relation to lifestyles is the concept of change. Major uncertainties stand in the way of making precise forecasts with respect to changing lifestyles and their impact on electricity consumption patterns. How can we predict future lifestyles? How can we relate a given lifestyle to the consumption of electricity?

Many of us live 20-30 miles from our work and even a few miles from a grocery store. The Commission has received information which suggests that many of us expect to change dwellings several times in a lifetime. Actually, in a metropolitian area like Toronto, the average household move is once every 5 years or, in other words, 20% of us move every year. In the past 10 years the number of persons per dwelling in Metropolitan Toronto has fallen from 3.6 persons to 2.6 persons.

It is important to raise the issue of the need for air-conditioning in Ontario. We have noted a trend in various parts of the United States by which the annual peak demand for electricity has shifted from the winter to the summer. This has occurred even in cities such as Milwaukee with an average January temperature less than Toronto and an average July temperature also less than Toronto. It is not improbable that if the price of electricity is "right" there could be an increase in electricity consumption in Southern Ontario during the summer months.

The work-leisure trade-off is another factor to be considered in our evolving pattern of lifestyles. Our affluent society, with its accompanying disposable income and quest for more leisure time, demands more and better social services as well as a higher level and greater variety of personal consumption. Our society has more free time to devote to sports and recreation and recent interest in health and fitness have tended to increase participation even more so. The consumer with more and more leisure time and greater expectations for his general well-being may impact significantly on the electrical supply system.

While there are indications that we will have more leisure time in the future, and hence an increased demand for leisure activities; there is also a very significant trend in

the working force which has implications for electric power planning. What will be the impact of an increased proportion of women, especially married women, in the labour force? How will this alter the present trends in home appliance use?

Historically the idea that demand for any consumer good might fall off was almost unthinkable; our standard of living and of consumption rose together. However the market for electric lighting in the home and for many home appliances may be approaching saturation. This means that everyone who wants electric lighting in the home has it or that the rate of increased demand may be stabilizing and may even begin to decline. Future growth in residential electricity consumption will probably be tied to the increase in the number of housing units. Electric space heating in the new housing market has been increasing over the past 15 years and this trend, we have been told, may continue unless electricity prices rise relative to other fuels enough to discourage it.

Some people have suggested that there is growing evidence that people now desire fewer tangibles than during the "consumer years". If this is so, we must account for it in forecasting future demands for electricity.

Since the late 1960's, there has been increasing concern on the part of various interest groups and the public in general, about the environment. However, concern about the environment may not necessarily lead directly to lower energy consumption. Environmental safeguards tend to increase the cost of energy and they may also increase the actual need. Quality of life is related to energy through such elements as food production, transportation, employment, shelter, etc. Most changes in our living patterns have direct implications on our patterns of energy demand.

The following questions outline some of the concerns raised which relate lifestyles to energy demand.

- To what extent is the maintenance of existing lifestyles (in the sense of living standards) in Ontario possible and/or desirable?
- Per capita energy consumption has increased almost in proportion to per capita income. Will this trend continue in the future? The historical relationship evolved during periods when energy prices were falling in relation to other prices. If energy prices increase, or if taxes are imposed on wasteful consumption and luxury items, how will per capita electricity consumption be affected?
- How does urban sprawl affect our consumption and growth patterns?

- Is the availability of a supply of electricity at present per capita levels, essential for economic and social well-being? Are we willing to pay the price in order to maintain our accustomed level of energy use?

- What mechanisms are required to motivate Ontario towards more rational energy usage? Can people be encouraged to buy energy-economic dwellings, office buildings and schools in spite of extra capital costs (but lower operating costs)?

- Are public education and persuasion in the style used by Ontario Ministry of Energy and the Federal Office of Energy Conservation sufficient?

(b) Limits to Growth

Today the principle of inherent limits of physical resources is a central concern in a society whose momentum pushes it onward to consume more, build more, do more and discard more.

Social limits to growth tie into this dilemma when there is a situation of competition for a depleting resource. If there is plenty of oil or land or clean water, there seem to be no physical limits to growth. It is when it is recognized that there is a limit to a resource that the social forces of competition begin and the fact of social limitations is evident.

To many people, the limits to growth dilemma has created the impression that growth would be good if we had unlimited resources and indeed, some people argue that we do have unlimited resources, that we will continue to develop technologies to rescue us from any impending disaster. However, there are also people who feel that, as technology becomes more and more complex, our social limits will be met in the form of personal alienation in an even more complex society, distrust of government and conflict between nations.

APPENDICES

The attached Appendices provide a sample of the comments relating to the future demand for electric power which were made during the preliminary public meetings and the public information hearings, together with references to the subject in the research and background papers prepared for the Commission. More detailed information on "future demand" is contained in the transcripts, memoranda, submissions, and research documents which are available in the Commission's Information Centre, 14 Carlton Street, Toronto, Ontario, M5B 1K5 and in the Regional Depositories located in the Main Libraries in Thunder Bay, Sudbury, London and Ottawa.

REFERENCES TO
"DEMAND FOR ELECTRIC POWER"
IN THE
PUBLIC INFORMATION HEARINGS

I. DEMOGRAPHIC ISSUES

II. ECONOMIC ACTIVITY

III. CONSERVATION

IV. UTILIZATION

V. LIFESTYLES

APPENDIX A

REFERENCE TO DEMAND DURING THE PRELIMINARY PUBLIC MEETINGS

I. DEMOGRAPHIC ISSUES

"Consider the potential of electric power planning for influencing the future population distribution of the Province of Ontario." S 98

"The Commission should address itself to the question of density of living." S202

"The demographic changes that led to rapid household formation and population growth during the last decade or so will not be repeated during the next decade; population will grow more slowly." S 58

"Population may not increase at the rate O.H. and TEIGA expect. Population future should be a public choice made by the citizens of Ontario and not be statisticians exprapolating trends." S102

"In keeping with the Federal Government's Programme on Immigration, and the trend of immigrants to the centres where basic industries are located, such as the City of Hamilton with its two steel mills, as well as a number of major secondary industries including tire manufacturing, electrical appliances and farm implements, the increase in population in the Hamilton area will continue for the unforeseeable future, which would indicate the need for continued expansion of electrical power in this area of Ontario." S150

II. ECONOMIC ACTIVITY

"Adequate electric power must be provided to designated growth centre and industrial areas sufficient to attract and accommodate the desired development." S136

"In Armstrong, Ontario, the existing generation cannot fulfill the present needs and consequently cannot fulfill the needs of potential industry." S178

II ECONOMIC ACTIVITY (Cont'd)

"Why is O.H. planning a 450% increase in electrical power generation for the Thunder Bay area by the year 2001 when population is only expected to increase 50%?" S174

"Can the provision of power be phased so as to permit controlled growth?" S 55

"If O.H. is forced to cut back services, how would this be done; who would pay the penalty through changed services and to what extent?" S 59

"The price of electricity and electrical appliances fell during the last two decades, encouraging consumption. O.H.'s own rate proposals clearly show that electricity prices will rise dramatically in the next few years, reducing or perhaps reversing the growth in consumption per capita." S 58

"... for the greater benefit of society as a whole, rural rates may have to be reduced." S114

"The price of electricity should be equalized throughout the province." S183

"Simple extrapolation cannot be accurate when factors influencing demand change between the historical period and the forecast period." S 58

"If Hydro bases its planning on a projected rise of annual demand for power of seven percent, what is the actual probability of such a demand?" S176

"We believe that this province's economic development in the past has been largely due to the ability of Ontario Hydro to meet the needs of the farm, industrial, commercial and residential communities. Unless the electrical need of these same sectors continue to be filled in the future, the people will be deprived of one of their most effective tools for avoiding and/or overcoming economic depression." S208

II ECONOMIC ACTIVITY (Cont'd)

"Sudbury is ideally situated at the cross-roads of north-south and east-west transportation routes, and this we see as one of the catalysts that will propel Sudbury into an extensive development program within the next few years. The Sudbury Region already displays the characteristics of a major growth centre within Northeastern Ontario, and it is imperative that the proper amenities be available when rapid development begins to occur. Of these amenities, we see energy as perhaps the most crucial in the face of quickly dwindling fossil fuel supplies. The current uncertainty over the supply of energy is acting as a constraint to expansion in Northern Ontario and has become a major obstacle to the development of the Sudbury Region." S 32

"The economic well-being of industry in Ontario is inextricable bound with the well-being of Ontario Hydro." S168

"... in the short term, supply restraints are potentially disasterous and ... for the next few years the risks of a shortage of electric energy in an energy dependant economy outweigh the risks of providing an adequate supply." S207

"... the threat of energy restrictions becomes one of the major concerns and influences our present operation, as well as casting a shadow over future development. It follows that if we, as an established industry in this area, are apprehensive of the future, new industry developments will be all but discouraged. Therefore, one of the first priorities of the Commission should be to publically state that Northwestern Ontario will not become the sacrificial lamb to the pundits of doom and zero growth and that the special requirements of this frontier of Ontario will be acknowledged." S177

III &
IV CONSERVATION AND UTILIZATION

"However, the continuity and reliability of service which can be provided within the limits set by the program or by the government plan and load projections by which it is modified should be the highest that Ontario Hydro's best technical capacity and expertise can determine and maintain. How high the level of service can be must be Ontario Hydro's responsibility to determine." S209

"It is impossible to discuss electricity without at the same time considering the utilization of fossil fuels. For example, many communities rely on seasonal shipments of oil. More generally, the Commission should study the availability of the premium fuels, gas and oil, which will in the long run, have to be reserved for premium functions (e.g., lubrication, feedstocks)." S 179

"In a heavily industrialized society such as in Ontario where more than 70% of the electricity generated is used by industrial and commercial sectors, reliability of electrical power supply should continue to be the most desirable approach in future planning." S149

III & IV CONSERVATION AND UTILIZATION (Cont'd)

"Consideration should be given to reducing current demand for, and the rate of growth of demand for new power production by educating power users, i.e., the public, the private sector, and the governments in reasonable use." S346

"Another area is conservation. As we move from a society based on conspicuous consumption to one based on conservation and recycling ethic, there are profound changes for energy consumption and lifestyles. Greater efficiency alone is not enough; we must be prepared to tax heavily or abolish unless energy consuming articles, such as electric toothbrushes; but price alone will not achieve significant savings except possibly in the industrial sector." S231

"In view of the massive waste or underutilization, if you like, of energy in Canada, we believe that conservation offers the best, least damaging solutions - economically, socially and environmentally - in the time frame under consideration by this Commission." S 58

"I personally wish to plead that every economic and effective means be employed to minimize waste of electrical energy, and to persuade the public and industry to abandon styles of life or styles of industrial operation that lead to unnecessary use of electrical energy." S165

"It must be obvious to us all that the days of high energy consumption without counting the cost are gone. The true hidden costs of past production are becoming known to us. Only partly are they financial." S211

"A comprehensive review of the subject of scheduled and interruptible power rates will materially assist in establishing incentives for industries to manage their electrical loads to the mutual advantage of themselves and Ontario Hydro." S168

CONSERVATION AND UTILIZATION (Cont'd)

"What changes in monetary charges for electrical power could be used to flatten peak load and reduce overall demand." S 89

"Rates should increase with increased use of electricity." S13,S31, S58,etc.

"Rates should be used to encourage conservation." S34,S40, S58,S89, S195,etc.

"Prices for electricity should never be lower than marginal cost, so that consumers are not encouraged to use electricity wastefully." S 58

"All hot water heating should be installed on a control basis for cut off at peak load." S 40

"All electric heating and air conditioning should be installed on control basis for cut-off at peak load." S 40

"It should be optional for load management so as to reduce the costs to the consumer." S 40

"The Association questions whether there is scope for the development of new incentive rates which would be applicable to the residential consumers. Such rates would both allow the residential consumer to economize his use of electricity and, by offering an incentive to use power at off-peak hours, would lead to greater utilization of existing capacity and reduce the need to build expensive new capacity." S103

"The conversion of selected fossil fuels and uranium into useful forms of energy can in most cases be accomplished more effectively and efficiently through the electrical mode and importantly, with less hostile impact on the environment." S177

APPENDIX B-1

I. DEMOGRAPHIC ISSUES

	Transcript Vol. No.	Page
Community Impact		
- community sizes, relationships with	19	2424-2427
Costing and Pricing Electricity		
- differential pricing for regionsl development - McKeough	41	5197-
District Heating		
- regional development - McKeough	41	5223-
Economic & Financial Factors		
- Electricity consumption growth - Drinkwalter	17	2029-2042
Load Forecast		
- load growth forecasting - Ministry of Industry and Tourism	32	4119-4135
- TEIGA's forecast - Higgins comments	45	5653-5668
- Houstan's request for TEIGA's	45	5682-5685
- original forecast of Sept. 1975	45	5659
	45	5666-5668
Ministry of Energy		
- regional planning and development - Rowan	64	7966-7973
Ministry of Housing		
- community planning	23	2931-2941
	23	2950-
- housing developments	23	2972-2982
- official plans	23	2931-2941
	23	2942-2944
- long range projections	23	2944-2950
	23	2963-
- purpose	23	2913-
- population projections	23	2928-2931
	23	2967-
Ministry of Treasury, Economics and Intergovernmental Affairs		
- load forecast	40	4994-5139
	41	5140-5144
- conclusion of the load forecast	40	4999-
- methodology and approach	40	5000-
	40	5028-
- why not Ontario Hydro's statistics for growth in consumption - Hay	40	5121-
- regional development	41	5178-5231
- North Channel	41	5194-5195

VI LIFESTYLES

"We respectfully request the Commissioners to address themselves to the effect of growth on the quality of life within the Province and the causes of that growth - for example: birth rate, death rate, immigration, per capita increased uses of electrical energy, as well as overall increases resulting from absolute numbers - the likely methods of control or arrest if needed and the implications for power planning, recognizing that the increasing lead times are required to put facilities into place and the consequences of either too little (shortages of supply) or too much (higher than required costs." S 59

"Public transit, both surface and sub-surface, hospitals, schools, pumping stations, sewage treatment plants, transportation, heating and ventilating in sealed high-rise buildings -- all and more are completely dependant on the reliability of the electric service available. More, the effective operation of any urban community depends upon the unquestioned conviction of its residents that all these essential services are and will be continuously available." S 52

"Not only are we experiencing unprecedented load growth, but one can also detect customer expectations for increasing service security and reliability. I must admit that while I am not prepared to quantify these last two factors, I am convinced that our customers expect greater service, security and reliability today than they did even (10) years ago. The measurement of this quality of service is difficult but it is one that requires attention and is, in fact, receiving greater attention from utility engineers today." S206

"As electricity becomes more expensive, people may become more willing to accept a system which offers less reliability if that would result in a price reduction." S103

	Transcript Vol. No.	Page
- energy centres	41	5195-5197
- differential pricing for	41	5197-
Provincial Development & Land Use		
- coordination with government	20	2487-
- community planning guidelines	20	2571-2582
- O.H. projects & regional development	20	2493-2531
- provincial development proposals		
- highlights - Miller	20	2487-2495
- highlights - Pogue	20	2471-2487

II. ECONOMIC ACTIVITY

	Transcript Vol. No.	Page
Costing and Pricing Electricity		
- comparative costs for a kilowatthour - Shaw	17	2140-2142
- costing and pricing study		
- subject of separate hearings	60	7447-
- pricing alternatives considered	60	7507-7508
- pricing for conservation	60	7512-7523
- would it affect Hydro's pricing policy?	60	7507-7508
- differential pricing for regional development - McKeough	41	5197-
- price increase less than CPI - why? - Drinkwalter	17	2142-2147
- pricing - Ministry of Industry and Tourism	32	4067-4077
	32	4051-
- for export	32	4099-4101
Load Forecast		
- conservation and load management	42	5253-5373
	43	5376-5442
- Bell, E.	43	5440-5442
- Bissett	42	5303-5307
- Conservation division	42	5257-
- budget	42	5272-
- conservation only talked not practised - St. Germain	42	5426-
- Harrison	42	5296-5303
	42	5362-5367
	43	5410-5416
- interruptibles for load management	43	5379-5388
- load growth forecasting - Ministry of Industry & Tourism	32	4119-4135
- load plan	42	5262-
	43	5388-5390
- load shedding	42	5336-5338
	43	5386-5388
- Lim, H.	43	5416-5426
- new technology for?	42	5283-
	42	5350-
- practical tips on	42	5368-5373
- Torrie	42	5307-5313
	43	5436-5440
- reliability effect of	42	5342-5347
- targets, and how to meet them	42	5265-
	43	5393-5410
- load forecasting - methodology, process errors, etc.	43	5442-5476
	44	5480-5593
	45	5595-5686

	Transcript Vol. No.	Page
- Bissett	44	5590-5593
- Harrison	44	5566-5584
	45	5673-5677
- Leach	44	5584-5590
	45	5669-5673
- Torrie	44	5547-5566
	45	5677-5682
- 'CANDIDE' & 'TRACE' models use in	45	5596-
	45	5605-
- consists essentially of forecasts of individual customers peak loads	44	5480-
- railways electrification	45	5601-5605
- role of chief economist	45	5651-5652
- tastes and life styles	45	5632-5650
	45	5681-5682
- TEIGA's forecast - Higgins comments	45	5653-5668
- Houstan's request for TEIGA's	45	5682-5685
- original forecast of Sept. 1975	45	5659-
	45	5666-5668
- unallocated load	45	5628-5632
- load plan	42	5262-
- storage heating	42	5326-
	42	5333-
- TEIGA's load forecasting evidence	40	4994-5139
	41	5140-5144
- 1976 load forecast approval by the Board	42	5261-
Ministry of Energy		
- load forecasting		
- capability duplication by the Ministry undesirable	64	7934-7938
- Ministry reviews and checks O. H. forecast	65	8056-
- no electricity - forecast by the Ministry	65	8045-8048
- rate structures	63	7867-7870
- social engineering within Hydro's terms of reference - Timbrell	63	7869-
Ministry of Industry and Tourism		
- load forecasting for industries	31	4119-4135
- studies for future requirements	33	4152-4157
Ministry of Treasury, Economics and Intergovernmental Affairs		
- electric energy & economic growth	38	4775-4779
- impact of Hydro's budget cuts	38	4782-4793
- Government spending & industries	38	4761-4774
- is Hydro industry or government	38	4762-
	38	4787-4793

	Transcript Vol. No.	Page
Ministry of Treasury, Economics and Intergovernmental Affairs (Cont'd)		
- load forecast	40	4994-5139
	41	5140-5144
- highlights - Jutlah	40	4997-4999
- conclusion of the load forecast	40	4999-
- methodology & approach	40	5000-
	40	5028-
- why load forecast by TEIGA	40	5023-5028
- Houston's examination	40	5040-5044
	40	5080-5121
- other ministries doing similar studies	40	5072-
- why not Ontario Hydro's statics for growth in consumption - Hay	40	5121-
- game theory applicability	40	5141-

III. CONSERVATION

	Transcript Vol. No.	Page
Conservation and Load Management		
- bulk metering		
- as a program for conservation	10	1286-1295
- Ministry of Housing evidence	23	2997-3003
- residentials paying cheap commercial rates	61	7643-7650
- division of Ontario Hydro	42	5257-
	42	5272-
- effect of rates	61	7561-7565
	61	7586-7607
	61	7651-7653
- special rates is government responsibility - Drinkwalter	60	7496-
- energy management program(energy bus) of Government of Ontario	33	4190-4202
- generation planning, considerations for	53	6619-6628
- load forecasting, impact on	42	5253-5373
	43	5376-5442
- Mooney's presentation	40	4993-4995
- potential in utilization	9	1093-
	9	1102-1116
	10	1201-1220
	10	1276-1283
- pricing for	60	7512-7523
- programs	9	1139-1142
	10	1210-1220
	10	1267-1269
- bulk metering	10	1286-1295
- bulk metering - Ministry of Housing evidence	23	2997-3003
- rationing electricity	10	1298-1299
- regulation	10	1322-
- talked but not practiced - St. Germain	42	5426
Conservation Programs - Ontario Hydro		
- industrial seminars	9	1142-
- home insulations - awareness in owners	9	1140-
Costing and Pricing Electricity		
- pricing for conservation	60	7512-7523
Generation Planning Processes		
- conservation considerations	53	6619-6628
- conservation and load management use in	51	6331-6386

	Transcript Vol. No.	Page
Load Forecast		
- conservation and load management	42	5253-5373
	43	5376-5442
- Bell, E.	43	5440-5442
- Bissett	42	5303-5307
- conservation division	42	5257-
- budget	42	5272-
- conservation only talked not practised - St. Germain	42	5426-
- Harrison	42	5296-5303
	42	5362-5367
	43	5410-5416
- interruptibles for load management	43	5379-5388
	43	5390-5393
- load management		
- customers acceptance of	42	5321-5328
- definition	42	5287-
- plans and program of O.H. -	42	5278-
	42	5336-5338
	43	5376-5388
	43	5390-5393
Ministry of Agriculture and Food		
- energy use in Agriculture and Food processing - George	21	2626-2630
- alternatives	22	2881-2885
- efficiencies	22	2850-2876
Ministry of Energy		
- conservation and employment	63	7848-7856
- conservation and load management		
- government policies	65	8138-8142
- research & development, policy and responsibilities	65	8172-8181
- role of municipal utilities	65	8153-8156
- targets to reduce energy consumption	65	8122-8134
- energy bus	65	8133-8134
- how to achieve	65	8125-
- industrial sectors' meeting with Mr. Gillespie	65	8129-
- 'watts from waste' project	65	8143-8148
- conservation programs	62	7760-
- difficulties in implementation-Rowe	65	8106-8122
- energy audit for buildings	65	8100-8105
- energy management programs of government may work at cross-purposes	65	8106-8122
- government credit fund for conservation measures	65	8098
- district heating		
- sites and studies	65	8148-8153
- comparison with solar heating	65	8151-8153

	Transcript Vol. No.	Page
Ministry of Energy (Cont'd)		
- energy audit		
- new projects, of	63	7924-7926
- conservation measures for demand estimates	65	8080-8082
- effect of conservation measures	65	8165-8174
- Ontario Hydro and municipal utilities	63	7831-
- conservation and bulk metering	63	7834-7835
- bulk metering be banned - select committee	63	7835-
Ministry of Industry & Tourism		
- energy management program (energy bus)	33	4190-4202
- examination by Houston	33	4211-4221
- 10% conservation is easy-Sandler	33	4192-
- problem with peak control?	33	4197-4200
- description of energy bus	33	4200-4202
Ministry of Housing		
- bulk metering	23	2997-3003
Ministry of Treasury, Economics and Intergovernmental Affairs		
- McKeough, D.A.		
- load management	39	4973-4980
Rate Structures		
- conservation effect of rates	61	7561-7565
	61	7586-7607
	61	7651-7653
- pricing for conservation	60	7512-7523

IV. UTILIZATION

	Transcript Vol. No.	Page
- bulk metering	10	1286-1295
- conservation		
- coordination with other utilities	10	1267-1269
- conservation programs	9	1139-1142
	10	1210-1220
	10	1267-1269
- efficiencies		
- Agriculture & Food	22	2850-2876
- appliances	10	1246-1250
	10	1258-1260
- furnace, industrial	10	1250-51
- motors	10	1251
	9	1117-1138
- electricity applications, of	9	1128-1138
	9	1137-
- incandescent lamps inefficient	10	1120-1229
- lightings	10	1238-1245
- electric application - potential growth	9	1143-1163
- heat pumps	9	1146-1160
- commercial applications	9	1159-1160
- residential application	9	1151-1159
- servicing difficulties	10	1299-
- electricity use in Ontario	9	1087-1116
- consumption comparisons	9	1087-1092
- conservation potential	9	1093-
	9	1102-1116
	10	1201-1220
- market segments	9	1094
	9	1097-1116
- potential growth	9	1143-1163
- secondary loads	9	1095-1097
- market share of Ontario Hydro	10	1260-1266
- fuel substitution possibilities	9	1169-1194
	10	1200-1210
- comparisons with gas	10	1317-1321
- highlights by Higgins	9	1174-1194
- gas should not be used for boilers - Wright	9	1122-
- highlights by Wright	9	1078-1085
- Ministry of Agriculture & Food Evidence	21	2626-2630
	22	2850-2888
- primary energy sources - Wright	9	1118-
- solar energy	9	1160-1163
	10	1196-1200
	10	1229-1234
- solar heating experiments	10	1306
- wind power		
- studies & research	10	1311-1316
- witness qualifications	9	1064-1077

	Transcript Vol. No.	Page
Load Forecast		
- railways electrification	45	5601-5605
Ministry of Agriculture & Food		
- agriculture as a viable industry		
- Durand	21	2686-2687
- efficiency of energy use	22	2850-
- Bio-Mass Research Inst , Manitoba	22	2860-2862
- crop drying	22	2857-2860
- district heating in agriculture	22	2864-2866
- greenhouses	22	2853-
- microwave drying	22	2853-
- non-farm uses	22	2866-
- standby generation in farms	22	2869-2876
- energy use in Agriculture & Food processing - George	21	2626-2630
- alternatives	22	2881-2885
- efficiencies	22	2850-2876
- soil quality - relative efficiencies	22	2886-2888
Ministry of Energy		
- energy supply and demand	63	7885-7926
	64	8009-
- Canadian demand	63	7893-
- conservations measures for demand estimates	65	8080-8082
- effect of conservation measures	65	8165-8174
- low temperature heat requirements - Fine/Rowe	65	8157-8163
- district heating	62	7745-7756
Ministry of the Environment		
- environmental protection		
- electrical energy utilization for	26	3393-3395
- research & monitoring by Ministry	26	3449-3452
Ministry of Industry & Tourism		
- energy for industries	32	4080-4150
- conversion to electricity	33	4183-4189
	33	4196-4211
- industry reliant on Ontario Hydro	32	4109-
- mining industry - Lamb	32	4116-4117
- load forecasting for industries	31	4119-4135
- is there real shortage of energy?	32	4078-4079
- highlights - Fleck	32	4035-4044
- Job opportunities		
- Hydro's cutbacks, effects on	33	4040-4043
- Ministry's main interest-job creation	33	4058-
- price increase, effects on	33	4062-6064
- load growth forecasting for industries	32	4119-4135
- price of competing fuels	32	4122-4129

	Transcript Vol. No.	Page
Ministry of Industry & Tourism (Cont'd)		
- electric vehicles	32	4131-4135
Ministry of Housing		
- housing developments	23	2972-2982
	23	2990-3019
	23	3043-3049
- heating systems and costing	23	3033-3043
- official plans		
- district heating	23	2931-2941
- electrical power	23	2942-2944
- long range projections	23	2944-2950
	23	2963-
Ministry of Natural Resources		
- energy need for resources industries	30	3828-3843
- resource industries		
- current value accounting for	30	3854-3856
- energy need and prices	30	3828-3843
	30	3856-
Ministry of Treasury, Economics and Intergovernmental Affairs		
- regional development	41	5178-5231
- energy centres	41	5195-5197
- district heating	41	5223-
Rate Structure		
- electric heating		
- cheaper to install	61	7567-
- cost calculations	61	7565-
- more expensive than others heatings	61	7566-
	61	7579-7580

V. LIFESTYLES

	Transcript Vol. No.	Page
Conservation and Load Management		
- effect of rates	61	7561-7565
	61	7586-7607
	61	7651-7653
- special rates is government responsibility - Drinkwalter		
- rationing electricity	10	1298-1299
- regulation	10	1322-
Costing and Pricing Electricity		
- price increase less than CPI - why? - Drinkwalter	17	2142-2147
Customer Generation	4	436-444
- social costs and benefits - Drinkwalter	17	2055-2060
Economic and Financial Factors		
- electricity consumption growth	17	2029-2042
- current value accounting - Drinkwalter	17	2036-2037
- electricity growing faster than economy	17	2029-2036
- service oriented economy - trend	17	2040-
Energy Utilization		
- efficiencies		
- Agriculture & Food	22	2850-2876
- appliances	10	1246-1250
	10	1258-1260
	10	1238-1245
- electric application -potential growth	9	1143-1163
- heat pumps	9	1146-1160
- commercial applications	9	1159-1160
- residential application	9	1151-1159
- servicing difficulties	10	1299-
- electricity use in Ontario	9	1087-1116
- consumption comparisons	9	1087-1092
- conservation potential	9	1093-
	9	1102-1116
	10	1201-1220
Farm Land Preservation		
- Ministry of Agriculture & Food evidence	21	2640-2700
	22	2749-
	22	2802-2814
Generation Environmental		
- fossil & nuclear pollutions	6	730-734
- hydraulic site development	7	853-856
- social effects	7	854-855
- nuclear safety - public concern Galinsky's comments	8	1026-1033

	Transcript Vol. No.	Page
Load Forecast		
- tastes and lifestyles	45	5632-5650
	45	5681-5682
Ministry of Agriculture & Food		
- agriculture as a viable industry - Durand	21	2686-2687
- agriculture v/s development - comparative weighing	22	2829-2849
- impact of industrial development	22	2770-2781
Ministry of Energy		
- energy consumption and lifestyles - Leiff	63	7856-7862
- energy supply and demand	63	7885-7926
	64	8009-
- load forecasting		
- no electricity - forecast by the Ministry	65	8045-8048
- social engineering	63	7869-
	63	7983-7988
Ministry of Industry & Tourism		
- expansion & holding industries in the Province	32	4138-4150
- new industries	32	4058-4060
- impact of budget cuts	33	4151-
	33	4157-4169
- studies for future requirements	33	4152-4157
- stable growth in construction, desirability of ECC report	33	4170-
- conversion to electricity	33	4183-4189
	33	4196-4211
	33	4221-4232
- is there real shortage of energy?	32	4078-4079
- highlights - Fleck	32	4035-4044
- Job opportunities		
- Hydro's cutbacks, effects on	33	4040-4043
- Ministry's main interest-job creation	33	4058-
- price increase, effects on	33	4062-6064
- load growth forecasting for industries	32	4119-4135
- price of competing fuels	32	4122-4129
- electric vehicles	32	4131-4135
- new industries		
- energy requirements	32	4058-4060
Ministry of Treasury, Economics and Intergovernmental Affairs		
- electric energy & economic growth	38	4775-4779

	Transcript Vol. No.	Page
Ministry of Treasury, Economics and Intergovernmental Affairs (Cont'd)		
- impact of Hydro's budget cuts	38	4782-4793
- Provincial Development and Land Use		
- provincial development proposals	20	2487-2495
	20	2471-2487

APPENDIX B-2

REFERENCE TO DEMAND ISSUES

IN

ONTARIO HYDRO MEMORANDA

	Exhibit No.	Page
I. DEMOGRAPHIC ISSUES		
Energy Utilization and the Role of Electricity	4	
Use of Electricity in Ontario		6.2-1
- General		6.2-1
- Use of Electricity in Residential Market Segment		6.2-4
- Use of Electricity in Commercial & Industrial Market Segments		6.2-7
Socio-Economic Factors	7	
Historical Relationships between Electrical Usage and Economic Development		4.1-1
Load Forecasting	19	
Forecasting Considerations & Methods		4
- General Remarks		4
- The Process of Growth		4
- The Effects of Price & Personal Income		7
- The Effects of Government Policy		8
Prospects for Electricity Demands in the Longer Term		14
- Effects of Other Factors		24
- Price		24
- Availability & Conservation		25
- Weather Effect & Winter Peak		25
- Taste & Lifestyles		29
Generation Planning Processes	21	
Requirements		3
- Electric Load		3
- Load Characteristics		5
- Possible Changes in Future Load Characteristics		10

	Exhibit No.	Page
II. ECONOMIC ACTIVITY		
Socio-Economic Factors	7	
- Provincial Economic Development		4.1-1
- Historical Relationships between Electrical Usage and Economic Development		4.1-1
- Ontario Hydro as a User of Limited Human, Material and Capital Resources		4.1-2
- Ontario Hydro as the Supplier of an Essential Factor of Production to Industry		4.1-3
Social Costs and Benefits		4.1-11
- General Discussion		4.1-11
- Defining Social Cost		4.1-12
- Defining Social Benefits		4.1-12
- External Costs and Benefits		4.1-12
Fuel Forecasting		4.1-17
- Introduction		4.1-17
- Source Data		4.1-17
(a) Main Sources		4.1-17
(b) Subsidiary Sources		4.1-18
(c) Trends in the Economy		4.1-18
(d) Calculations		4.1-18
Capital Availability		4.1-25
Basis for Setting Aggregate Revenue Requirements		4.1-35 4.1-36
Provincial Development and Land Use Factors	8	
- Introduction		1
- Provincial Development Proposals		2
- Major Land Use Policy Areas		5
(a) Agricultural Lands		
(b) Community Planning (New Towns)		
(c) Conservation Authorities and Provincial Parks		
(d) Transportation and Communications		
- Ontario Hydro Projects and Regional Development		13
- Existing Projects		14
- Future Projects		18
Fuels Supply	17	
Fuels Requirements		1
- Introduction		1
- Strategy		1
- Future Requirements		2

	Exhibit No.	Page
Load Forecasting	19	
Forecasting Considerations and Methods		4
- General Remarks		4
- The Process of Growth		4
- The Effects of Price and Personal Income		7
- The Effects of Government Policy		8
The Forecasting Process		9
- General Remarks		9
- Load Forecasting in Ontario		10
Prospects for Electricity Demands in the Longer Term		14
Effect of Other Factors		24
- Price		24
- Availability and Conservation		25
- Weather Effect on Winter Peak		25
Uncertainties and Risks		26
Taste and Lifestyle		29
Ontario Hydro Load Plan		33
- General		33
- Ontario Hydro Conservation Targets		34
- The 1976 Load Plan		35
Generation Planning Processes	21	
Load Characteristics		5
- Possible Changes in Future Load Characteristics		10
- Ontario Hydro's Current Proposed Generation Development Program up to 1995		65
- Basis of Selection of Ontario Hydro's Proposed Program		65
Impact of Rate Structures and Rate Levels	24	
Introduction		1
Historical Background		1
- General		11
- Ontario		15
- Municipal Residential Rates		15
- Municipal Commercial Rates		18
- Municipal Industrial Power Rates		19
- Rural Rates		20
- Direct Industrial Rates		22

	Exhibit No.	Page
Alternative Rate Structures		24
- Residential Customers		24
- Commercial and Industrial Customers		26
- Other Rate Concepts		27
Rate Structure Trends in Hydro		28
Price Elasticity		30
III and IV THE UTILIZATION AND CONSERVATION OF ENERGY		
Generation: Scientific & Technological	2	
Utilization Heat Rejected to the Cooling Water		
- General		2.2-76
- Space Heating		2.2-76
- Acquaculture		2.2-77
- Agriculture		2.2-77
- Recreational Use		2.2-79
Energy Utilization and the Role of Electricity	4	
Use of Electricity in Ontario		6.2-1
- General		6.2-1
Use of Electricity In Residential Market Segment		6.2-4
Use of Electricity in Commercial and Industrial Market Segments		6.2-7
Efficiency in Electric Energy Utilization		6.3-1
- Introduction		6.3-1
- Primary Energy Sources		6.3-1
- Sources of Electric Energy		6.3-4
- Electricity's Share of Energy Market by Segment at Point of Application		6.3-5
- Application Efficiency of Electricity Use by End Use		6.3-6
- Efficiency of Electricity Use		6.3-7
- Space Heating		6.3-8
- Residential		6.3-8
- Commercial		6.3-9
- Heat Pump		6.3-9
- Appliances		6.3-9
- Water Heater		6.3-9
- Range		6.3-9
- Clothes Dryer		6.3-10
- Refrigerator		6.3-10
- Lighting		6.3-10

	Exhibit No.	Page
Potential Improvements in Utilization Efficiency		6.3-11
Significance of Improvements in Efficiency		6.3-11
Ontario Hydro's Energy Conservation/Energy Management Program		6.4-1
- Introduction		6.4-1
- Work with Government Agencies		6.4-3
- Ontario Hydro's Energy Management Program		6.4-4
- Residential Segment		6.4-4
(a) "Conservenergy"		
(b) Heat Pump Evaluation and Development		
(c) Electric Space Conditioning		
(d) Development of Performance Standards		
(e) Displays		
(f) Communications		
(g) Technical Consultation Service		
(h) Joint Energy Industry Conservation Committee		
(i) Development of New Techniques for Reinsulation of Existing Housing Stock		
- Industrial Segment		6.4-10
(a) Energy Management Seminars		
(b) In-Plant Energy Management Committees		
(c) The Ontario Energy Flow Chart		
- Agricultural Segment		6.4-13
(a) Industry Contacts		
(b) Technical Training and Services		
- Commercial Segment		6.4-14
(a) Design of New Buildings		
(b) Conservation in Existing Buildings		
(c) Energy Application Information		
(d) Computer Programs		
Potential Growth in the Applications of Electrical Energy		6.5-1
- Introduction		6.5-1
- Transportation		6.5-2
- Electric Road Vehicles		6.5-3
- Electrified Railroads		6.5-4
Conversions of Fossil Fuel-Fired Industrial Processes to Electric Heat		6.5-5
- Heat Treating		6.5-5
- Forging		6.5-5
- Melting		6.5-6

	Exhibit No.	Page
Impact of Environmental Regulation In Industry		6.5-6
- Heat Recovery Processes		6.5-7
- Heat Pump Applications		6.5-9
- Residential and Small Commercial		6.5-9
- Large Commercial Buildings		6.5-10
- Light Industrial		6.5-11
- Thermal Storage		6.5-12
- Domestic Water Heating		6.5-12
- Space Conditioning - Commercial		6.5-13
- Space Conditioning - Residential		6.5-14
- Infra-Red Heating		6.5-15
- Commercial and Industrial		6.5-15
- Agricultural		6.5-16
(a) Commercial Brooding		
(b) Other Uses		
- Heating of High Density Row and Town Housing		6.5-17
- District Heating		6.5-17
- Solar Heating		6.5-18
- Residential Energy Consumption		6.5-18
- Solar Energy Systems		6.5-19
(a) Solar Heating - No Storage		
(b) Solar Heating - One Day Storage		
(c) Soalr Heating with Seasonal Storage		
- Energy and Demand of Solar Heating Systems		6.5-19
(a) Solar Heating - No Storage		
(b) Solar Heating - One Day Storage		
(c) Solar Heating with Seasonal Storage		
- Conslusion		
Possibilities of Fuel Substitution - Outlook		6.6-1
- Introduction		6.6-1
- Price Outlook		6.6-2
- Availability Outlook		6.6-3
- The Outlook for Real Income		6.6-6
- The Outlook for Interfuel Substitution		6.6-6
Fuels Supply	17	
- Conservation Aspects		20
- Constraints and Factors		20
- Nuclear-Based Generation		21
- Generation Based on Oil and Gas		23
V. LIFESTYLES		
Public Participation	1	
Involvement of the Public in Planning Future Ontario Hydro Projects		1-20

	Exhibit No.	Page
- Concepts for Future Involvement		1-20
(a) General Principles		
(b) Opportunities for Public Involvement in the Planning Program		
(c) Techniques for Communicating with the Public		
(d) Public Acceptance of the Process		
Public Participation in the Decision Making Process		1-24
Energy Utilization and the Role of Electricity	4	
Distribution of Electricity		6.1-1
- Role of Hydro in the Distribution of Electricity		6.1-1
Regulatory Responsibilities of Ontario Hydro		6.1-13
- Safety		6.1-13
- Rates and Charges		6.1-14
- Review of Ontario Hydro Wholesale Rates		6.1-15
- Use of Electricity in Ontario		6.2-1
- Use of Electricity in Residential Market Segment		6.2-4
- Use of Electricity in Commercial and Industrial Market Segments		6.2-7
Potential Growth in the Applications of Electrical Energy		6.5-1
- Introduction		6.5-1
- Transportation		6.5-2
- Electric Road Vehicles		6.5-3
- Electricifed Railroads		6.5-4
- Heating of High Density Row and Town Housing		6.5-17
- District Heating		6.5-17
- Solar Heating		6.5-18
- Residential Energy Consumption		6.5-18
- Solar Energy Systems		6.5-19
(a) Solar Heating - No Storage		
(b) Solar Heating - One Day Storage		
(c) Solar Heating with Seasonal Storage		
- Energy & Demand of Solar Heating Systems		6.5-19
(a) Solar Heating - No Storage		
(b) Solar Heating - One Day Storage		
(c) Solar Heating with Seasonal Storage		
- Conclusion		

	Exhibit No.	Page
Possibilities of Fuel Substitution -Outlook		6.6-1
- Introduction		6.6-1
- Price Outlook		6.6-2
- Availability Outlook		6.6-3
- The Outlook for Real Estate		6.6-6
- The Outlook for Interfuel Substitution		6.6-6
Socio-Economic Factors	7	
- Social Costs and Benefits		4.1-11
- Defining Social Cost		4.1-12
- Defining Social Benefits		4.1-12
Load Forecasting	19	
- Task and Lifestyle		29
Impact of Rate Structures and Rate Levels	24	
- Rate Structure Trends in Hydro		28

REFERENCES TO DEMAND ISSUES IN MINISTRY SUBMISSIONS AT THE PUBLIC INFORMATION HEARINGS

	Exhibit No.	Page
Ministry of Agriculture and Food	9	
- Energy Use in the Agriculture & Food Industry		5
- Maxamizing Efficiency of Energy in Agriculture		21
- Direct Studies		
- Energy Management and Conservation Studies		
- Associated Research Resulting in an Indirect Effect on Energy Utilization		
- Communication of Research Results		
Ministry of Energy - Part I	13	
- Alternative Technologies		5-1
- District Heating		
- Efficiency of Automobiles and Trains		
- Energy Conservation		
- Energy Management Program		2-1
- Monitoring Supply & Demand		3-1
Ministry of Energy - Part II	13	
- Areas of Policy Guidance		
- General Government Policies - Conservation		50
- Policies Specific to Ontario Hydro - Load Management		59
- Exploitation of Technology		62
Ministry of Environment	Preliminary Submission	
- Demand and "need"		14
- Energy Conservation		35
- Rate of Load Growth		36
Ministry of Health	9	
- Lifestyle	Section VI	

	Transcript Vol. No.	Page
Ministry of Housing	10	
- Future Issues of Mutual Concern		8
- Community Planning		8
- Housing Development		10
Ministry of Industry & Tourism	15	
- Introduction and Ministry Objectives		1-1
- Role of Manufacturing in Economy		2-1
- Role of Electricity in Manufacturing		3-1
- Utilization and Cost of Electricity in Manufacturing		4-1
- Role of Power Pricing and Its Effect on Industry		5-1
- Availability and Price as it Affects Regional Development		6-1
- Changes in Energy Sources and Conversion to Electricity		7-1
- Role of the Ministry in Energy Management Programs		9-1
Ministry of Treasury, Economics and Intergovernmental Affairs	18	
- Demand for Electric Energy in Ontario		12
- perspective		12
- Determinants of the Demand for electricity in Ontario		14
- Projections of Electric Energy Demand in Ontario		19
- Economic and Regional Development considerations		
- Rate Structure		76
Appendix: Economic Impact of Hydro Rate Increase		
- Growth in Ontario's Demand for Electric Energy		18-1
- A long term projection of Ontario's industrial development pattern		18-2
- Long term outlook for Labour Force Growth: Canada and Ontario		18-3
- Long term economic outlook for Ontario		18-4

PUBLIC INFORMATION HEARINGS

LIST OF EXHIBITS

DEMAND ISSUES

TOPIC 4: ENERGY UTILIZATION

Exhibit No.	
4-1	Evolution of Energy Requirements in Ontario #76-1 (to come)
4-3	Relative Electricity Consumption per Capita World Aug = 100
4-4	Memo dated January 6, 1971 from Larry Higgins entitled "Marketing in the 70's".
4-6	Rosette Chart, Canadian Energy Corporation in relation to Power Reserves (for 1972).
4-7	Ontario Industrial Energy Use.
4-8	Ontario Residential and Commercial Energy Use.
4-9	North York Hydro Rate Schedule effective January 1, 1976.
4-10	Consumer's Gas Rate Schedule effective February, 1976.
4-11	Annual Home Energy Cost Comparison, Table prepared and supplied by Ontario Hydro

TOPIC 12: MINISTRY OF THE ENVIRONMENT

12-1	Preliminary Submission of the Ministry of Environment.

TOPIC 13: MINISTRY OF ENERGY

13-4	Ministry of Energy compilation of background data on the Energy Management Program together with a cover sheet.
13-5	Booklet published by the Ministry of Education entitled Energy Conservation for Schools.
13-8	Charts referred to by Dr. Ian Rowe respecting the Energy Management Program (to be supplied).

TOPIC 15: MINISTRY OF INDUSTRY AND TOURISM

15-4	Manpower Study, tabled by W. A. Ledingham

Exhibit No.	
15-4	Graph entitled "Ontario Hydro Electric Demand", a supplement to Figure 7-1.
15-7	Pilot Report relating employment in the service industry to employment in manufacturing (referred to on 2-3).

TOPIC 18: MINISTRY OF TREASURY, ECONOMICS AND INTERGOVERNMENTAL AFFAIRS

18-1	Growth in Ontario's Demand for Electric Energy.
18-2	A Long Term Projection of Ontario's Industrial Development Pattern.
18-3	Long Term Outlook for Labour Force Growth: Canada and Ontario.
18-4	Long Term Economic Outlook for Ontario.

TOPIC 19: LOAD FORECASTING

19-1	1976 Load Forecast by Ontario Hydro No. 760209.
19-2	Hydro Board of Directors Minutes Dated March 8, 1976: - Memo of March 5, 1976 - Appendix - Tables, Graph
19-3	Memorandum of March 17, 1976 savings converted to Megawatts.
19-4	Chart of Ontario Hydro entitled Shape of Ten Highest Peak Days (1975-76)

APPENDIX C

RESEARCH AND BACKGROUND PAPERS DEVELOPED BY THE COMMISSION

Fuels - The Supply and Demand	Dr. L. Bertin
Socio-Economic and Institutional Factors in Electric Power Planning	Dr. C. Hooker
A Study of Awareness, Attitudes and Future Expectations of Ontario Residents Regarding the Supply and Use of Electrical Energy	Semper Paratus Ltd.
The Role of Ontario Hydro as an Economic Development Tool of the Province	J. O. Dean
A Preliminary Study of the Conceptual and Institutional Structure of Energy Policy Making in Ontario and its Policy Alternatives	Dr. C. A. Hooker
Efficient Utilization of Energy	W. Murgatroyd Imperial College of Science & Technology London England

RESEARCH PAPERS
FUNDED BY THE COMMISSION

Foodland Steering Committee

Research includes:

- impact of Hydro growth on Ontario economy, food production, industrial growth;
- future food and energy needs.

Hydro Electric Power Commission - Nepean Township

To study and report on the subject of electrical energy conservation; in the rural and urban environment, co-ordinated with other hydro's in the area, N.R.C., Federal Government, appropriate Ministries, local large industries, etc.

Energy Probe

To assess the economic, environmental and social feasibility of Ontario Hydro's proposed generating program and to compare the implications of this program with alternative strategies for Ontario's energy future.

Sierra Club

Analysis of Ontario Hydro's Studies of reserve margins, reliability, generation plan, load management and pricing policy.